

### **REMARKS**

Claims 1, 2, 5, 7-19, 21, 22, 24-40, 42 and 43 are rejected. Claims 1, 21, and 42 have been amended. Claims 1, 2, 5, 7-19, 21, 22, 24-40, 42 and 43 are presently pending in the application. Favorable reconsideration of the application in view of the following remarks is respectfully requested.

The basis for the amendment of claims 1, 21, and 42 is found on page 19, line 3 of the specification as originally filed, as well as reinstating the claims entered in the Response dated May, 26, 2004, in response the Office Action dated March 29, 2004.

#### **Specification:**

The Examiner has objected to the amendment filed April 29, 2005 under 35 U.S.C. 132 because it introduces new matter into the disclosure with respect to the recitation of claims 1, 21 and 42 that the microbeads are free of colorant. The Applicants have canceled this new matter accordingly.

#### **Rejection of Claims 1, 21 and 42 under 35 USC § 112:**

The Examiner has rejected Claims 1, 21 and 42 under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention, as the recitation of claims 1, 21 and 42 that "the microbeads are free of colorant" constitutes new matter. The Applicants have canceled this new matter accordingly.

#### **Rejection of Claims 1, 21 and 42 under 35 USC § 112:**

The Examiner has rejected Claims 1, 21 and 42 under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention, as the recitation "on exposure to UV light of 50 Klux for one week" renders claims 1, 21 and 42 indefinite because the scope of the claim cannot be ascertained since the recitation "on exposure to UV light of 50 Klux for one week" is a conditional limitation: the claim recites that the change in b\* value is less than or equal to 0.2 "on exposure to UV light of 50 Klux for one week", but does not require that the article be "expos[ed] to UV light of 50 Klux for one week". The wording of claims 1, 21, and 42 have been amended accordingly.

**Rejection of Claims 1, 21 and 42 under 35 USC § 112:**

The Examiner has rejected Claims 1, 21 and 42 under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention, as the use of "CIELAB value" in the claims renders the claims indefinite since CIELAB is a tradename, and, since the computer programs associated with trademarks and tradenames may change with time, the specification must specify the nature of the b\* value.

The term b\*, as explained in a response, dated Feb 4, 04, to an Office communication, is understood by those skilled in the art of colorimetry. "b\*" is an axis of the CIELAB color scale, wherein b\* is the color axis from yellow to blue, indicating "yellowness" of a color. CIELAB is a well-known tool for indicating color in a three-dimensional chart, indicating hue and shade, and has been readily available to those of ordinary skill in the art since at least 1976. See Attachments LMBA-1, LMBA-2 and LMBA-3. The present specification at page 4, lines 25-28, and at page 18, line 31, - page 19, line 4, states that the change in b\* is defined as the change in yellowness on the CIELAB color scale under exposure to UV light. The start point of the change in b\* would be the original color of a microbead as measured on the b\* axis before exposure to UV light. The final color is a color achieved after exposure of the microbead to UV radiation. The examples in the specification were conducted in a time period of one week, with an amount of UV light approximating sunlight of 50 Klux, as set forth at page 18, lines 31-32. Thus, change in b\*, or  $\Delta b^*$ , is clearly defined in the specification and claims 1 and 21 as the change in yellowness caused by UV exposure as measured on the CIELAB color scale.

Further evidence of use of both the CIELAB standard and the term b\* is contained in patent literature, in the specification, as well as the claims. See U.S. Pat. No. 4,363,888 ("*After drying the paints, their colour co-ordinates L, a and b (CIELAB 1976) where measured using a Gardener XL23 Colourmeter. A full description of the CIELAB system is given in Supplement No. 2 to CIE publication No. 15 (E-1.3.1) 1971)/(TC-1.3) 1978.*"); U.S. Pat. No. 4,546,045 (Claim "5. *A method for reducing the temperature rise associated with sunlight exposure of heat sensitive polymeric substrates, which comprises coating the heat sensitive polymeric substrate with a coating composition comprising a film-*

*forming polymer and an effective amount of an infrared reflective pigment, said coating composition having a CIELAB L\* value of up to 70 and resulting in the coating substrate reflecting at least 45 percent of impinging infrared energy.”); U.S. Pat. No. 7,056,634 (Claim “1. A yellow toner comprising a yellow toner particle that contains at least a binder resin, a wax, and a yellow pigment containing a monoazo compound represented by a formula (1) as follows, wherein a value of a\* is in the range of -5 to +14 when b\* is +80.....”); U.S. Pat. No. 5,434,684 (Claim “3. An apparatus according to claim 1, wherein the color expression form is a form expressing color by L\*, a\*, and b\* components.”); U.S. Pat. No. 4,403,866 (Claim “1. A process for making a paint that matches the color values of a standard liquid paint, said process utilizes a computer electrically connected to a multiplicity of metering pumps, each pump being individually connected to a supply of a component used in the paint, said components used in the paint being liquid containing binder for the paint, solvent for the paint and colorant in the form of dispersions or solutions, a vessel containing a recycle loop and mixing means, a pump tubularly connected to the vessel positioned in a recycle loop, a cell having a viewing window positioned in the recycle loop, a colorimeter having means to determine L\*, a\* and b\* values of the paint positioned to view the window of the cell and being electrically connected to the computer, said process being controlled by the computer comprises the following steps: (1) providing the computer with (a) formula of the paint, (b) L\*, a\* and b\* values of the liquid standard paint, (c) tolerance values of L\*, a\* and b\* for the paint; (2) metering exact amounts of components of the paint into the mixing vessel by the metering pumps which are being controlled by the computer; (3) mixing said components to form a paint; (4) circulating the paint through said cell at a uniform shear rate; (5) measuring and determining L\*, a\* and b\* values of the paint with the colorimeter; (6) transmitting said L\*, a\* and b\* values to the computer; (7) determining color vectors of each colorant used to formulate said paint by adding a known amount of each colorant to the paint and for each addition repeating Steps (3)-(6) and determining the change in L\*, a\* and b\* values; (8) comparing by the computer the L\*, a\* and b\* values of the paint to the L\*, a\* and b\* values of the standard paint and calculating the difference between the values of the paint and the standard paint, and calculating the quantity of components to be added to the*

*paint to bring the paint within  $L^*$ ,  $a^*$  and  $b^*$  tolerance values of the paint; and (9) repeating steps (2)-(6) and (8) at least once in the event the paint is not within the  $L^*$ ,  $a^*$  and  $b^*$  tolerance values for the paint to bring the paint within these tolerance values.”); U.S. Pat. No. 5,105,267 (Claim “2. The color conversion apparatus to claim 1, in which said colorimetric system converting means is a ROM containing data for converting the separated color data signals of R (red), G (green), and B (blue) to color data of factors  $L^*$ ,  $a^*$  and  $b^*$  defining a color space.”); U.S. Pat. No. 5,116,711 (Claim “1. A black developer for developing electrostatic latent images, comprising: (1d) a black toner composition containing a black toner which in turn contains at least a binder resin and two or more colorants, and hydrophobic silica fine powder and (2d) a ferrite carrier coated with a mixture of a fluorine-containing resin and a styrene type resin in a weight ratio of 90:10 to 20:80, wherein the binder resin comprises a styrene-acrylic acid ester type resin or a polyester ester, the ferrite carrier has an average particle size of 30-60 microns, and the ferrite carrier is coated with 0.01 to 5 wt. % based on the carrier of the mixture of the fluorine-containing resin and the styrene type resin; the black toner having a volume particle size of 11.0 to 14.0 microns, containing 30% by number or less of particles having sizes below 6.35 microns and containing 9% by weight or less of particles having sizes above 20.2 microns; the black toner composition having an agglomeration degree of 25% or below and an apparent density of 0.2 to 1.5 g/cm.<sup>3</sup>; the black toner having an apparent viscosity of 100.degree. C. of 10. <sup>sup.4</sup> to 5.times.10.<sup>sup.5</sup> poise, an apparent viscosity of 90.degree. C. of 5. <sup>times.10.<sup>sup.4</sup></sup> to 5.times.10.<sup>sup.6</sup> poise, a DSC heat-absorption peak at 58. degree. to 72.degree. C., and a gloss of 5.0% or higher; the black toner having chromaticity values of  $a^*=-3.5$  to 6.5,  $b^*=-6.0$  to 4.0, and  $L^*=26.0$  to 36.0; the black toner showing a triboelectric charge of -5 to -20 micro- C/g with respect to the ferrite carrier coated with the mixture of the fluorine- containing resin and the styrene type resin containing 70 wt. % or more of carrier particles having sizes of 250 mesh-pass and 350 mesh- on and the black toner having a spectral reflectance of 60% or more in an infrared region of 900 to 1,000 nm.”)*

The Applicants believe and have provided evidence that one of ordinary skill in the art at the time the invention would understand the use of

"CIELAB value" in the claims, as well as the nature of the b\* value, and, therefore, the usage of the terms is not indefinite.

**Rejection of Claims 1, 2, 5, 7, 9-17, 21, 22, 24-26, 28-36 and 39 Under 35**

**U.S.C. §102:**

The Examiner has rejected Claims 1, 2, 5, 7, 9-17, 21, 22, 24-26, 28-36 and 39 35 U.S.C. 102(b) as being anticipated by Maier et al., indicating that, in regard to claims 1, 2, 5, 7, 17, 21, 22, 24-26, 36 and 39, Maier et al. teach a shaped article such as a film, sheet, bottle (a container), tube, fiber or rod having a continuous first polymer phase having dispersed therein microbeads of a crosslinked second polymer that are bordered by void space, acrylic acid, methyl acrylate or methyl methacrylate is a typical monomer for making the crosslinked second polymer for making the microbeads, the monomers from which the second polymer is derived, acrylic acid, methyl acrylate or methyl methacrylate, therefore, comprise less than 10 wt% styrenic monomers and less than one wt% styrenic monomers as claimed in claims 2 and 22 (i.e. 0 wt% styrenic monomers). The Examiner indicates that the compositions taught by Maier et al. have superior thermal stability, in regard to the recitation of claim 21 that the microbeads are made from acrylic crosslinking monomers, Maier et al. teach that the microbeads are made from methyl methacrylate monomers, which are acrylic crosslinking monomers, the recitation "experiencing a 2% weight loss above 270°C" defines thermally stable as experiencing a weight loss of less than 2% at temperatures below 270°C; since Maier et al. teach the shaped article comprising the microbeads as claimed by Applicant having the same composition as that claimed by Applicant, the microbeads of Maier et al. are necessarily thermally stable as Applicant has defined thermally stable, Maier et al. teach that the article is virtually free of the "yellowing with time" problem that "plagues cellulose-based papers, and, therefore, Maier et al. teach that the microbeads have a change in CIELAB value b\* of less than 0.2 towards yellowness on exposure to UV light of 50 Klux for one week.

Maier (U.S. Pat. No. 5, 275, 854) discloses a shaped article comprising a continuous oriented thermoplastic polymer matrix having dispersed therein microbeads of a polymer which are at least partially bordered by void space, the microbeads being present in an amount of about 5-50% weight based on the weight of said oriented thermoplastic, said void space occupying about 2-

60% by volume of said shaped article. Preferably, the microbeads are cross-linked to an extent they will be resilient and elastic at the orientation temperature, and are coated with a slip agent. The shaped article is preferably in the form of a sheet, fibers, or other molded article, and preferably has a relatively low specific gravity and whiteness.

The present invention relates to a shaped article comprising a continuous first polymer phase having dispersed therein microbeads of a cross-linked second polymer, wherein the cross-linked second polymer is derived from monomers that comprise less than 10 wt% styrenic monomers and are selected from the group consisting of acrylic and allylic monomers. The microbeads are bordered by void space and are thermally stable, experiencing a 2% weight loss above 270°C. The microbeads also have a change in CIELAB value b\* towards yellowness after one week exposure to UV light of 50 Klux, wherein the change in b\* is less than or equal to 0.2.

A claim is anticipated only if each and every element as set forth in the claim is found either expressly or inherently described in a single prior art reference. The identical invention must be shown in as complete detail as is contained in the claim. Maier et al. does not disclose shaped articles or thermal receiver sheets comprising microbeads having less than 10 wt% styrenic monomers, that have a change in CIELAB value b\* of less than 0.2 towards yellowness on exposure to UV light of 50 Klux for one week and a thermal stability of a 2% weight loss above 270°C. The microbeads disclosed in Maier et al. do not inherently meet the limitations of the present claims. This is demonstrated by the following Tables AF-1 and AF-2.

**TABLE AF-1**  
**YELLOWNESS EVALUATION**

<i>Linear monomer</i>		<i>Crosslink monomer</i>		<i>Yellowness <math>\Delta b^*</math></i>	<i>Comparative (C) or Invention (I)</i>	<i>Location in Maier</i>
<i>Name</i>	<i>amt wt%</i>	<i>Name</i>	<i>amt wt%</i>	<i>Target <math>\leq 0.2</math></i>		
<i>Methyl methacrylate</i>	70%	<i>Divinyl benzene</i>	30%	0.254	C	Col. 7 (Linear, x-link), Ex. 15, 17, 23 & 25
<i>Methyl methacrylate</i>	90%	<i>Divinyl benzene</i>	10%	0.150	I	Col. 7 (Linear, x-link), Ex. 15, 17, 23 & 25

The italics print in the first 5 columns of Table AF-1 is an excerpt from Table 1, pg. 23, of the specification as originally filed. No additional data or new matter has been added to these columns. The sixth column indicates whether the sample is a comparative sample or an inventive sample according to the present invention. The seventh column identifies the location of the sample composition in Maier. As can be seen from Table AF-1, the disclosure of Maier does not disclose materials that inherently satisfy the requirement that “the microbeads have a change in CIELAB value b\* towards yellowness after one week exposure to UV light of 50 Klux, wherein the change in b\* is less than or equal to 0.2”.

**Table AF-2**

**THERMAL STABILITY EVALUATION SUMMARY**

<i>Linear monomer</i>		<i>Crosslink monomer</i>		<i>2% loss temp</i>	<i>Comparative or Invention</i>	<i>Location in Maier</i>
<i>Name</i>	<i>amt wt%</i>	<i>Name</i>	<i>amt wt%</i>	<i>Target &gt;270 °C</i>		
<i>Methyl methacrylate</i> (Table 5 as filed)	70%	<i>allyl methacrylate</i>	30%	200	C	Col. 7 (Linear, x-linker)
<i>Methyl methacrylate</i> (Declaration of Smith)	70%	<i>Divinylbenzene</i>	30%	300	C	Col. 7 (Linear, x-link), Ex. 15, 17, 23 & 25, <u>YELLOW</u> (SEE Table 1)
<i>Methyl methacrylate</i> (Table 5 as filed)	70%	<i>diallyl maleate</i>	30%	<200	C	Col. 7 (Linear, x-linker)

The italics print in the first 5 columns of Table AF-2 is excerpted from Table 5, identified in the first column of Table AF-2, from pg. 26 of the specification as originally filed, and a sample, originally present in Table 1 and measured for yellowness, which was then measured for thermal stability and included in the Declaration of Smith, submitted in the response, dated November 4, 2003. No additional data or new matter has been added to these columns. The sixth column indicates whether the sample is a comparative sample or an inventive sample according to the present invention. The seventh column identifies the location of the sample composition in Maier. As can be seen from Table AF-2, the disclosure of Maier does not disclose materials that inherently

satisfy the requirement that “the microbeads are thermally stable, experiencing a 2% weight loss above 270°C”. In addition, Maier fails to disclose a microbead having less than 10 wt% styrenic monomers, that have a change in CIELAB value b\* of less than 0.2 towards yellowness on exposure to UV light of 50 Klux for one week and as well as a thermal stability of a 2% weight loss above 270°C.

Therefore, since Maier fails to expressly or inherently disclose microbeads having less than 10 wt% styrenic monomers, which are thermally stable, experiencing a 2% weight loss above 270°C, and which also have a change in CIELAB value b\* towards yellowness after one week exposure to UV light of 50 Klux, wherein the change in b\* is less than or equal to 0.2, Maier fails to anticipate the present claims.

In regard to claims 9-16 and 28-35, these claims benefit from dependence on claims 1 and 21, which, as discussed above, Applicants believe is patentable with respect to Maier.

**Rejection Of Claims 18, 19, 37, 38 Under 35 U.S.C. §103(a):**

The Examiner has rejected Claims 18, 19, 37 and 38 under 35 U.S.C. 103(a) as being unpatentable over Maier et al., indicating that Maier et al. teach that methyl methacrylate is a preferred monomer for making the crosslinked polymer and, although Maier et al. fail to explicitly teach that the second polymer is derived from monomers comprising more than 20 wt% of crosslinking monomer, Maier et al. discloses that the polymer of the microbeads is crosslinked to the extent of having a resiliency or elasticity at orientation temperatures of the matrix polymer such that a generally spherical shape of the crosslinked polymer is maintained after orientation of the matrix polymer, making it obvious to one of ordinary skill in the art at the time the invention was made to have varied the concentration of the crosslinking agent of Maier et al. in order to achieve the optimal resiliency or elasticity at orientation temperatures of the matrix polymer depending on the monomer used as the monomer from which the second polymer is derived and depending on the particular desired end user-result, in the absence of unexpected results.

Maier (U.S. Pat. No. 5, 275, 854) discloses a shaped article comprising a continuous oriented thermoplastic polymer matrix having dispersed therein microbeads of a polymer which are at least partially bordered by void space, the microbeads being present in an amount of about 5-50% weight based



on the weight of said oriented thermoplastic, said void space occupying about 2-60% by volume of said shaped article. Preferably, the microbeads are cross-linked to an extent they will be resilient and elastic at the orientation temperature, and are coated with a slip agent. The shaped article is preferably in the form of a sheet, fibers, or other molded article, and preferably has a relatively low specific gravity and whiteness.

The present invention relates to a shaped article comprising a continuous first polymer phase having dispersed therein microbeads of a cross-linked second polymer, wherein the cross-linked second polymer is derived from monomers that comprise less than 10 wt% styrenic monomers and are selected from the group consisting of acrylic and allylic monomers. The microbeads are bordered by void space and are thermally stable, experiencing a 2% weight loss above 270°C. The microbeads also have a change in CIELAB value b\* towards yellowness after one week exposure to UV light of 50 Klux, wherein the change in b\* is less than or equal to 0.2.

To establish a prima facie case of obviousness, there must be some suggestion or motivation in the reference or in the general knowledge available to one skilled in the art to modify the reference, there must be a reasonable expectation of success, and the prior art reference must teach or suggest all the claim limitations.

Maier et al. teach a broad recitation of possible monomers at col. 7, lines 13-56. Maier fails to disclose microbeads of a cross-linked second polymer, wherein the cross-linked second polymer is derived from monomers that comprise less than 10 wt% styrenic monomers and are selected from the group consisting of acrylic and allylic monomers, are bordered by void space, are thermally stable, experiencing a 2% weight loss above 270°C, and which also have a change in CIELAB value b\* towards yellowness after one week exposure to UV light of 50 Klux, wherein the change in b\* is less than or equal to 0.2.

The examples in Maier '854 use either 95 mole % methyl methacrylate and 5 mole % divinylbenzene (crosslinker) or 70 mole % methyl methacrylate and 30 mole % divinylbenzene (crosslinker). This calculates to 93.6 wt % / 6.4 wt % and 64.2 wt % / 35.8 wt % respectively.

Linear monomer		Crosslink monomer		2% loss temp
Name	amt wt%	Name	amt wt%	Target $\geq 270^{\circ}\text{C}$
Methyl methacrylate	70%	Divinylbenzene	30%	300
Methyl methacrylate	90%	Divinylbenzene	10%	260
Methyl methacrylate	95%	Divinylbenzene	5%	<260

The above table, copied from the Declaration of Smith, shows the 2% temperature loss for methyl methacrylate crosslinked with different amounts of divinylbenzene. The thermal stability data for 30% and 10% divinylbenzene crosslink monomer was measured on the same samples used to measure the yellowness as shown in Table 1 of the subject patent application, page 20. As shown in the Table above and in Table 6 of the subject patent application, pages 23-24, thermal stability decreases with decreasing crosslink monomer. This information, in combination with the results shown for the 30% and 10% crosslink monomer in the above table, indicates the same trend holds true for methacrylic, acrylic or styrenic crosslink monomers. The thermal stability for a 5% crosslink monomer, per the examples of Maier, has not been measured. However, since the sample with 10% crosslink monomer in the above Table failed to provide the required thermal stability, in light of the trends identified in Table 6 of the specification, the sample with 5% crosslink monomer would not be expected to provide the necessary thermal stability when a sample tested with a higher level of crosslink monomer has failed. Table AF-1, above, already illustrates that the yellowness of a sample with 30% divinylbenzene crosslink monomer is unacceptable. Therefore, Maier fails to teach or suggest microbeads of a cross-linked second polymer, wherein the cross-linked second polymer is derived from monomers that comprise less than 10 wt% styrenic monomers, which are thermally stable, experiencing a 2% weight loss above  $270^{\circ}\text{C}$  and which also have a change in CIELAB value  $b^*$  towards yellowness after one week exposure to UV light of 50 Klux, wherein the change in  $b^*$  is less than or equal to 0.2

The Examiner has previously found this unpersuasive, indicating *"As stated in paragraph 5 of the Advisory Action (Paper 10), Applicant asserts a showing of unexpected results, but Applicant has not met the burden on Applicant to establish that these results are unexpected and significant in that the evidence relied upon does not establish "that the differences in results arc in fact*

*unexpected and unobvious and of both statistical and practical significance" Ex parte Gelles, 22 USPQ2d 1318, 1319 (Bd. Pat. App. & Inter. 1992) because the claimed invention has not been compared with the closest prior art which is commensurate in scope with the claims as required by MPEP 716.02(b); Dennis E. Smith states on page 2 of his Declaration that "The thermal stability for a 5% crosslink monomer, per the examples of Maier, has not been measured". The first two lines of the table provided in the declaration are taken from the specification of the instant application and the third line of the table is speculatively extrapolated data as indicated on page 2 of the declaration. Any validity of the third line of this table and of the explained reasoning behind making the extrapolation is destroyed by Applicants own statement that "it is difficult to predict what amount of a specific crosslinking monomer will produce a desired thermal stability"'. The term "extrapolate" was used to describe the means of making the above conclusion. The Compact Oxford Dictionary defines the term "extrapolate" as: "1 extend the application of (a method, conclusion, etc.) to different or larger groups. 2 extend (a graph) by inferring unknown values from trends in the known data."'. The conclusion was reached, based on the extrapolation of actual test data. The term "predict" was used to indicate that, unless testing was conducted, one could not tell beforehand, in the absence of data, whether or not a particular combination would supply the necessary thermal stability. To rephrase Applicants previous statement, one cannot tell in advance, without testing, whether or not a material composition will provide the necessary claimed results. However, once at least two data points of a composition, varying the amount of crosslink monomer, have been determined to establish a line, and, hence, a trend, predictions can be made about the results that will be produced by a material of the same composition, varied for the amount of crosslinking monomer. Thus, as stated in the Declaration, extrapolating the trend shows that reducing the amount of styrenic monomer to less than 10wt% would result in a 2% weight loss at a temperature below 260°C. Thus, a microbead formed from a polymer including a styrenic monomer in an amount less than 10wt% would not have Applicants' claimed thermal stability, that is, a 2% weight loss above 270°C.*

Maier et al. does not recognize the problem of thermal stability in various formulations of microbeads. Maier et al. also does not recognize the problem of yellowness in the microbeads, or the resultant shaped article or thermal

transfer receiving sheet, under exposure to UV light. As shown in Applicants' specification in Tables 4 and 5 on pages 22 and 23, it is difficult to predict in advance, without analyzing actual formulations, what amount of a specific crosslinking monomer will produce a desired thermal stability. For example, in Table 4, numerous examples having 30% crosslinking monomer are within Applicants' claimed thermal stability, while another crosslinking monomer at 30%, diethylene glycol diacrylate, is outside the claimed thermal stability. Applicants have recognized thermal stability and yellowness as problems in the area of shaped articles and thermal transfer receiving sheets, and have identified a criterium for forming such shaped articles and thermal transfer receiving sheets. The criterium for achieving the desired properties of yellowness and thermal stability is selection of microbeads having less than 10 wt % styrenic monomers selected from the group consisting of acrylic and allylic monomers and a 2% weight loss at a temperature above 270°C. In addition, Maier et al. does not teach use of less than 10 wt% styrenic monomers while maintaining thermal stability of the resultant microbead. Styrenic monomers such as divinylbenzene are exemplified at col. 7, lines 44-46, of Maier et al. as cross-linking agents, and are used in the examples. Tables 1, 2, 5, 6, 9, and 10 exemplify polystyrene as a cross-linker in an amount of either 5% or 30%. However, Maier et al. does not disclose the thermal stability of the microbeads having 5% polystyrene. Reducing the amount of styrenic monomer (polystyrene) to below 10% would result in a 2% weight loss at a temperature less than 270°C, as shown in the attached Declaration of Dennis E. Smith, previously submitted on November 4, 2003. As shown in the Declaration of Smith, a reduction of styrenic monomers alone results in weight loss at a decreased temperature. The use of 30 wt % divinyl benzene results in a 2% weight loss at a temperature of 300°C, and the use of 10wt% divinyl benzene results in a 2% weight loss at a temperature of 260°C. Maier et al. therefore does not teach or suggest that a formulation of a microbead with less than 10 wt% styrenic monomers would have a thermal stability of a 2% weight loss above 270°C, a have a change in CIELAB value b\* of less than 0.2 towards yellowness on exposure to UV light of 50 Klux for one week and a thermal stability of a 2% weight loss above 270°C, let alone both, as presently claimed.

Maier et al. does not disclose all the present claim limitations, as there is no mention that shaped articles or thermal receiver sheets comprising

microbeads having a have a change in CIELAB value b\* of less than 0.2 towards yellowness on exposure to UV light of 50 Klux for one week and/or a thermal stability of a 2% weight loss above 270°C.

Applicants have shown, in the attached Declaration of Dennis E. Smith, and in the specification, the unexpected results of improved thermal stability and decreased yellowness achieved with the claimed invention, which problems are not taught, suggested, or resolved in Maier et al.

Since Maier fails to suggest the modification necessary to achieve the present claims, fails to provide any likelihood of success, and fails to disclose all the limitations of the present claims, and, in light of surprising results, the Applicants believe that the presently claimed invention is not obvious in view of Maier and request that the Examiner reconsider and withdraw the rejection.

**Rejection Of Claims 8, and 27 Under 35 U.S.C. §103(a):**

The Examiner has rejected Claims 8 and 27 under 35 U.S.C. 103(a) as being unpatentable over Maier et al. in view of Saito et al., as Maier et al. teach the article as discussed above, and, although Maier et al. fail to teach that the microbeads comprise a copolymer derived from methylmethacrylate and 1,6-hexanediol diacrylate or from methylmethacrylate and trimethylol propane triacrylate, Saito et al. disclose a transfer sheet having a thermally transferable protective layer and optionally a protective layer having an acrylic resin to improve the fastness properties, such as rubbing fastness and scratch fastness, of the protective layer/s, Saito et al. disclose that methylmethacrylate, 1,6-hexanediol diacrylate and trimethylol propane triacrylate are suitable acrylic monomers, Saito et al. disclose the use of the disclosed acrylic monomers as a mixture of two or more of the monomers, therefore, Saito et al. disclose the use of copolymers derived from methylmethacrylate and 1,6-hexanediol diacrylate or from methylmethacrylate and trimethylol propane triacrylate, so that one of ordinary skill in the art would have recognized to have used a copolymer of methylmethacrylate and 1,6-hexanediol diacrylate or of methylmethacrylate and trimethylol propane triacrylate as the acrylic polymer of Maier et al. in order to improve the fastness properties, such as rubbing fastness and scratch fastness, of the article of Maier et al. as taught by Saito et al, making it obvious to one of ordinary skill in the art at the time the invention was made to have used a copolymer of methylmethacrylate and 1,6-hexanediol diacrylate or of

methacrylate and trimethylol propane triacrylate as the acrylic polymer of Maier et al. in order to improve the fastness properties, such as rubbing fastness and scratch fastness, of the article of Maier et al. as taught by Saito et al.

Maier (U.S. Pat. No. 5, 275, 854) discloses a shaped article comprising a continuous oriented thermoplastic polymer matrix having dispersed therein microbeads of a polymer which are at least partially bordered by void space, the microbeads being present in an amount of about 5-50% weight based on the weight of said oriented thermoplastic, said void space occupying about 2-60% by volume of said shaped article. Preferably, the microbeads are cross-linked to an extent they will be resilient and elastic at the orientation temperature, and are coated with a slip agent. The shaped article is preferably in the form of a sheet, fibers, or other molded article, and preferably has a relatively low specific gravity and whiteness.

Saito discloses a protective layer transfer sheet comprising: a substrate sheet; and a thermally transferable protective layer provided on at least a part of one side of the substrate sheet, the protective layer comprising at least an aromatic polycarbonate resin which is soluble in a nonhalogenated solvent and has a glass transition temperature  $T_g$  of 80.degree. C. or above. There is also provided a print comprising a substrate having, on at least one side thereof, at least a dye image and a protective layer covering at least a part of the image, the protective layer having been formed by transfer from the above protective layer transfer sheet.

The present invention relates to a shaped article comprising a continuous first polymer phase having dispersed therein microbeads of a cross-linked second polymer, wherein the cross-linked second polymer is derived from monomers that comprise less than 10 wt% styrenic monomers and are selected from the group consisting of acrylic and allylic monomers. The microbeads are bordered by void space and are thermally stable, experiencing a 2% weight loss above 270°C. The microbeads also have a change in CIELAB value  $b^*$  towards yellowness after one week exposure to UV light of 50 Klux, wherein the change in  $b^*$  is less than or equal to 0.2.

To establish a prima facie case of obviousness, there must be some suggestion or motivation in the reference or in the general knowledge available to one skilled in the art to modify the reference, there must be a reasonable

expectation of success, and the prior art reference must teach or suggest all the claim limitations.

Maier et al. teach a broad recitation of possible monomers at col. 7, lines 13-56. Maier fails to disclose microbeads of a cross-linked second polymer, wherein the cross-linked second polymer is derived from monomers that comprise less than 10 wt% styrenic monomers and are selected from the group consisting of acrylic and allylic monomers, are bordered by void space, are thermally stable, experiencing a 2% weight loss above 270°C, and which also have a change in CIELAB value  $b^*$  towards yellowness after one week exposure to UV light of 50 Klux, wherein the change in  $b^*$  is less than or equal to 0.2. Saito also fails to disclose microbeads of a cross-linked second polymer, wherein the cross-linked second polymer is derived from monomers that comprise less than 10 wt% styrenic monomers and are selected from the group consisting of acrylic and allylic monomers. Saito fails to mention microbeads bordered by void space. Saito fails to disclose microbeads which are thermally stable, experiencing a 2% weight loss above 270°C, and which also have a change in CIELAB value  $b^*$  towards yellowness after one week exposure to UV light of 50 Klux, wherein the change in  $b^*$  is less than or equal to 0.2.

Maier et al. does not recognize the problem of thermal stability in various formulations of microbeads. Maier et al. also does not recognize the problem of yellowness in the microbeads, or the resultant shaped article or thermal transfer receiving sheet, under exposure to UV light. Saito also fails to mention the problems of thermal stability and yellowness as presently defined in the claims. As discussed above, it is difficult to predict in advance, without analyzing actual formulations, what amount of a specific crosslinking monomer will produce a desired thermal stability, what composition will produce a particular change in yellowness and what compositions will provide both. Applicants have recognized thermal stability and yellowness as problems in the area of shaped articles and thermal transfer receiving sheets, and have identified a criterium for forming such shaped articles and thermal transfer receiving sheets. The criterium for achieving the desired properties of yellowness and thermal stability is selection of microbeads having less than 10 wt % styrenic monomers, and are selected from the group consisting of acrylic and allylic monomers. Maier and Saito fail to provide any likelihood of success in producing a microbead having a change in

CIELAB value b\* of less than 0.2 towards yellowness on exposure to UV light of 50 Klux for one week and/or a thermal stability of a 2% weight loss above 270°C.

Maier and Saito do not disclose all the present claim limitations, as there is no mention that shaped articles or thermal receiver sheets comprising microbeads having a change in CIELAB value b\* of less than 0.2 towards yellowness on exposure to UV light of 50 Klux for one week and/or a thermal stability of a 2% weight loss above 270°C.

Since Maier and Saito fail to suggest the modification necessary to achieve the present claims, fail to provide any likelihood of success, and fail to disclose all the limitations of the present claims, the Applicants believe that the presently claimed invention is not obvious in view of Maier and request that the Examiner reconsider and withdraw the rejection.

**Rejection Of Claim 40 Under 35 U.S.C. §103(a):**

The Examiner has rejected Claim 40 under 35 U.S.C. 103(a) as being unpatentable over Maier et al. in view of Hart et al, as Maier et al. teach the article as discussed above, and, although Maier et al. fail to teach that the shaped article is coated with a slip agent comprising silica or alumina, Hart et al. disclose a thermal transfer printing receiver sheet that is coated with a coating that contains a silica slip agent to improve the slip, anti-blocking and general handling characteristics of the sheet so that one of ordinary skill in the art would have recognized to have coated the article with a slip agent in order to improve the slip, anti-blocking and general handling characteristics of the article as taught by Hart et al, making it obvious to one of ordinary skill in the art at the time the invention was made to have to have coated the article with a slip agent in order to improve the slip, antiblocking and general handling characteristics of the article as taught by Hart et al.

Maier (U.S. Pat. No. 5, 275, 854) discloses a shaped article comprising a continuous oriented thermoplastic polymer matrix having dispersed therein microbeads of a polymer which are at least partially bordered by void space, the microbeads being present in an amount of about 5-50% weight based on the weight of said oriented thermoplastic, said void space occupying about 2-60% by volume of said shaped article. Preferably, the microbeads are cross-linked to an extent they will be resilient and elastic at the orientation temperature, and are coated with a slip agent. The shaped article is preferably in the form of a



sheet, fibers, or other molded article, and preferably has a relatively low specific gravity and whiteness.

Hart discloses a thermal transfer printing (TTP) receiver sheet for use in association with a compatible donor sheet, comprises a supporting substrate having, on at least one surface thereof, (a) a dye-receptive receiving layer to receive a dye thermally transferred from the donor sheet, said receiver sheet additionally comprises, on at least one surface thereof, (b) an antistatic layer, said antistatic layer preferably being on a second surface of said substrate. The antistatic layer preferably comprises (a) a polychlorhydrin ether of an ethoxylated hydroxyamine and (b) a polyglycol amine, the total alkali metal content of components (a) and (b) not exceeding 0.5% of the combined weight of (a) and (b).

The present invention relates to a shaped article comprising a continuous first polymer phase having dispersed therein microbeads of a cross-linked second polymer, wherein the cross-linked second polymer is derived from monomers that comprise less than 10 wt% styrenic monomers and are selected from the group consisting of acrylic and allylic monomers. The microbeads are bordered by void space and are thermally stable, experiencing a 2% weight loss above 270°C. The microbeads also have a change in CIELAB value  $b^*$  towards yellowness after one week exposure to UV light of 50 Klux, wherein the change in  $b^*$  is less than or equal to 0.2.

To establish a prima facie case of obviousness, there must be some suggestion or motivation in the reference or in the general knowledge available to one skilled in the art to modify the reference, there must be a reasonable expectation of success, and the prior art reference must teach or suggest all the claim limitations.

Maier et al. teach a broad recitation of possible monomers at col. 7, lines 13-56. Maier fails to disclose microbeads of a cross-linked second polymer, wherein the cross-linked second polymer is derived from monomer that comprise less than 10 wt% styrenic monomers and are selected from the group consisting of acrylic and allylic monomers, are bordered by void space, are thermally stable, experiencing a 2% weight loss above 270°C, and which also have a change in CIELAB value  $b^*$  towards yellowness after one week exposure to UV light of 50 Klux, wherein the change in  $b^*$  is less than or equal to 0.2. Hart also fails to disclose microbeads of a cross-linked second polymer, wherein the cross-linked

second polymer is derived from monomers that comprise less than 10 wt% styrenic monomers and are selected from the group consisting of acrylic and allylic monomers, and which also have a change in CIELAB value  $b^*$  towards yellowness after one week exposure to UV light of 50 Klux, wherein the change in  $b^*$  is less than or equal to 0.2.

Maier et al. does not recognize the problem of thermal stability in various formulations of microbeads. Maier et al. also does not recognize the problem of yellowness in the microbeads, or the resultant shaped article or thermal transfer receiving sheet, under exposure to UV light. Hart also fails to mention the problems of yellowness as presently defined in the claims. As discussed above, it is difficult to predict in advance, without analyzing actual formulations, what amount of a specific crosslinking monomer will produce a desired thermal stability, what composition will produce a particular change in yellowness and what compositions will provide both. Applicants have recognized thermal stability and yellowness as problems in the area of shaped articles and thermal transfer receiving sheets, and have identified a criterium for forming such shaped articles and thermal transfer receiving sheets. The criterium for achieving the desired properties of yellowness and thermal stability is selection of microbeads having less than 10 wt % styrenic monomers, and are selected from the group consisting of acrylic and allylic monomers. Maier and Hart fail to provide any likelihood of success in producing a microbead having a change in CIELAB value  $b^*$  of less than 0.2 towards yellowness on exposure to UV light of 50 Klux for one week in combination with a thermal stability of a 2% weight loss above 270°C.

Maier and Hart do not disclose all the present claim limitations, as there is no mention that shaped articles or thermal receiver sheets comprising microbeads having a change in CIELAB value  $b^*$  of less than 0.2 towards yellowness on exposure to UV light of 50 Klux for one week and a thermal stability of a 2% weight loss above 270°C.

Since Maier and Hart fail to suggest the modification necessary to achieve the present claims, fail to provide any likelihood of success, and fail to disclose all the limitations of the present claims, the Applicants believe that the presently claimed invention is not obvious in view of Maier and request that the Examiner reconsider and withdraw the rejection.

**Rejection Of Claims 42 and 43 Under 35 U.S.C. §103(a):**

The Examiner has rejected Claims 42 and 43 under 35 U.S.C. 103(a) as being unpatentable over Maier et al. in view of Harrison et al, indicating that Maier et al. teach a sheet having a continuous first polymer phase having dispersed therein microbeads of a crosslinked second polymer that are bordered by void space, that acrylic acid, methyl acrylate or methyl methacrylate is a typical monomer for making the crosslinked second polymer for making the microbeads, the monomers from which the second polymer is derived, acrylic acid, methyl acrylate or methyl methacrylate comprise not more than 10 wt% styrenic monomer, that acrylic acid, methyl acrylate and methyl methacrylate are acrylic monomers, as acrylates are polymers of acrylic acid or its esters, as evidenced by Hawley's Condensed Chemical Dictionary, the compositions taught by Maier et al. have superior thermal stability, Maier et al. teach the sheet comprising the microbeads as claimed by Applicant having the same composition as claimed by Applicant, and therefore, the microbeads of Maier et al. are necessarily thermally stable where thermally stable means that the temperature at which the microbeads experience a 2% weight loss is above 270°C, the article is virtually free of the "yellowing with time" problem that "plagues cellulose-based papers, the microbeads are free of colorant, and, although Maier et al. fail to teach that the sheet is a dye diffusion thermal transfer dye receiving sheet, Harrison et al. disclose a dye diffusion thermal transfer dye receiving element comprising a support comprising a continuous oriented polymer matrix having dispersed therein microbeads of a cross-linked polymer which are at least partially bordered by void space, the dye-receiving element is shaped in sheet form so that one of ordinary skill in the art would have recognized to have used the sheet of Maier et al. as a dye diffusion thermal transfer dye receiving sheet since it is well known to use a sheet comprising a continuous polymer matrix having dispersed therein microbeads of a crosslinked polymer which are at least partially bordered by void space such as the sheet of Maier et al. as a dye diffusion thermal transfer dye receiving sheet as taught by Harrison et al, making it obvious to one of ordinary skill in the art at the time the invention was made to have used the sheet of "Maier et al. as a dye diffusion thermal transfer dye receiving sheet since it is well known to use a sheet comprising a continuous polymer matrix having dispersed therein microbeads of a cross-linked polymer which are at least partially bordered by void

space such as the sheet of Maier et al. as a dye diffusion thermal transfer dye receiving sheet as taught by Harrison et al.

Maier (U.S. Pat. No. 5, 275, 854) discloses a shaped article comprising a continuous oriented thermoplastic polymer matrix having dispersed therein microbeads of a polymer which are at least partially bordered by void space, the microbeads being present in an amount of about 5-50% weight based on the weight of said oriented thermoplastic, said void space occupying about 2-60% by volume of said shaped article. Preferably, the microbeads are cross-linked to an extent they will be resilient and elastic at the orientation temperature, and are coated with a slip agent. The shaped article is preferably in the form of a sheet, fibers, or other molded article, and preferably has a relatively low specific gravity and whiteness.

Harrison discloses a dye-receiving element for thermal dye transfer including a support having thereon a polymeric dye image-receiving layer wherein the support includes a continuous oriented polymer matrix having dispersed therein microbeads of a cross-linked polymer coated with a slip agent and which are at least partially bordered by void space.

The present invention relates to a shaped article comprising a continuous first polymer phase having dispersed therein microbeads of a cross-linked second polymer, wherein the cross-linked second polymer is derived from monomers that comprise less than 10 wt% styrenic monomers and are selected from the group consisting of acrylic and allylic monomers. The microbeads are bordered by void space and are thermally stable, experiencing a 2% weight loss above 270°C. The microbeads also have a change in CIELAB value  $b^*$  towards yellowness after one week exposure to UV light of 50 Klux, wherein the change in  $b^*$  is less than or equal to 0.2.

To establish a prima facie case of obviousness, there must be some suggestion or motivation in the reference or in the general knowledge available to one skilled in the art to modify the reference, there must be a reasonable expectation of success, and the prior art reference must teach or suggest all the claim limitations.

Maier et al. teach a broad recitation of possible monomers at col. 7, lines 13-56. Maier fails to disclose microbeads of a cross-linked second polymer, wherein the cross-linked second polymer is derived from monomers that comprise

less than 10 wt% styrenic monomers and are selected from the group consisting of acrylic and allylic monomers, are bordered by void space, are thermally stable, experiencing a 2% weight loss above 270°C, and which also have a change in CIELAB value  $b^*$  towards yellowness after one week exposure to UV light of 50 Klux, wherein the change in  $b^*$  is less than or equal to 0.2. Harrison also fails to disclose microbeads of a cross-linked second polymer, wherein the cross-linked second polymer is derived from monomers that comprise less than 10 wt% styrenic monomers and are selected from the group consisting of acrylic and allylic monomers, are thermally stable, experiencing a 2% weight loss above 270°C, and which also have a change in CIELAB value  $b^*$  towards yellowness after one week exposure to UV light of 50 Klux, wherein the change in  $b^*$  is less than or equal to 0.2.

Maier et al. does not recognize the problem of thermal stability in various formulations of microbeads. Maier et al. also does not recognize the problem of yellowness in the microbeads, or the resultant shaped article or thermal transfer receiving sheet, under exposure to UV light. Harrison also fails to mention the problems of thermal stability and yellowness as presently defined in the claims. As discussed above, it is difficult to predict in advance, without analyzing actual formulations, what amount of a specific crosslinking monomer will produce a desired thermal stability, what composition will produce a particular change in yellowness and what compositions will provide both. Applicants have recognized thermal stability and yellowness as problems in the area of shaped articles and thermal transfer receiving sheets, and have identified a criterium for forming such shaped articles and thermal transfer receiving sheets. The criterium for achieving the desired properties of yellowness and thermal stability is selection of microbeads having less than 10 wt % styrenic monomers, and are selected from the group consisting of acrylic and allylic monomers. Maier and Harrison fail to provide any likelihood of success in producing a microbead having a change in CIELAB value  $b^*$  of less than 0.2 towards yellowness on exposure to UV light of 50 Klux for one week and/or a thermal stability of a 2% weight loss above 270°C.


Maier and Harrison do not disclose all the present claim limitations, as there is no mention that shaped articles or thermal receiver sheets comprising microbeads having a change in CIELAB value  $b^*$  of less than 0.2 towards

yellowness on exposure to UV light of 50 Klux for one week and/or a thermal stability of a 2% weight loss above 270°C.

Since Maier and Harrison fail to suggest the modification necessary to achieve the present claims, fail to provide any likelihood of success, and fail to disclose all the limitations of the present claims, the Applicants believe that the presently claimed invention is not obvious in view of Maier and request that the Examiner reconsider and withdraw the rejection.

It is believed that the foregoing is a complete response to the Office Action and that the claims are in condition for allowance. Favorable reconsideration and early passage to issue is therefore earnestly solicited.

Respectfully submitted,

  
\_\_\_\_\_  
Attorney for Applicant(s)  
Registration No. 42,334

Lynne M. Blank/ct  
Rochester, NY 14650  
Telephone: 585-477-7418  
Facsimile: 585-477-1148

Enclosed: Attachments

If the Examiner is unable to reach the Applicant(s) Attorney at the telephone number provided, the Examiner is requested to communicate with Eastman Kodak Company Patent Operations at (585) 477-4656.

# Lab color space

From Wikipedia, the free encyclopedia

**CIE  $L^*a^*b^*$  (CIELAB)** is the most complete color model used conventionally to describe all the colors visible to the human eye. It was developed for this specific purpose by the International Commission on Illumination (*Commission Internationale d'Eclairage*, hence its *CIE* initialism). *The  $*$  after  $L$ ,  $a$  and  $b$  are part of the full name, since they represent  $L^*$ ,  $a^*$  and  $b^*$ , derived from  $L$ ,  $a$  and  $b$ .*

The three parameters in the model represent the lightness of the color ( $L^*$ ,  $L^*=0$  yields black and  $L^*=100$  indicates white), its position between magenta and green ( $a^*$ , negative values indicate green while positive values indicate magenta) and its position between yellow and blue ( $b^*$ , negative values indicate blue and positive values indicate yellow).

The Lab color model has been created to serve as a device independent, absolute model to be used as a reference. Therefore it is crucial to realize that the visual representations of the full gamut of colors in this model are never accurate. They are there just to help in understanding the concept, but they are inherently inaccurate.

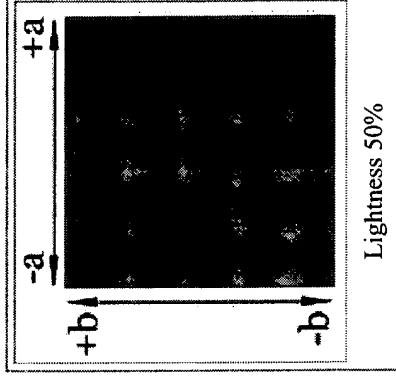
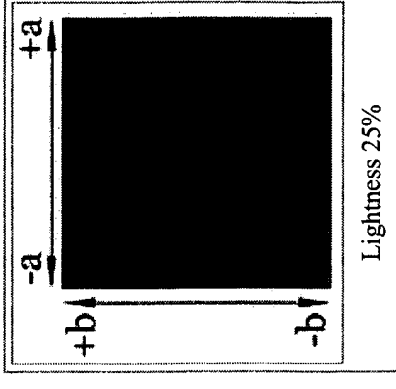
Since the Lab model is a three dimensional model, it can only be represented properly in a three dimensional space. A useful feature of the model however is that the first parameter is extremely intuitive: changing its value is like changing the brightness setting in a TV set. Therefore only a few representations of some horizontal "slices" in the model are enough to conceptually visualize the whole gamut, assuming that the luminance would be represented on the vertical axis.

CIE 1976  $L^*a^*b^*$  is based directly on the CIE 1931 XYZ color space as an attempt to linearize the perceptibility of color differences, using the color difference metric described by the MacAdam ellipse. The non-linear relations for  $L^*$ ,  $a^*$ , and  $b^*$  are intended to mimic the logarithmic response of the eye. Coloring information is referred to the color of the white point of the system, subscript  $n$ .

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  - 1.1 The forward transformation
  - 1.2 The reverse transformation
- 2 XYZ to CIELUV & CIELUV to XYZ conversions
  - 2.1 The forward transformation
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- 3 RGB and CMYK conversions

## XYZ to CIE $L^*a^*b^*$ (CIELAB) and CIELAB to XYZ conversions

### The forward transformation

$$\begin{aligned} L^* &= 116 f(Y/Y_n) - 16 \\ a^* &= 500 [f(X/X_n) - f(Y/Y_n)] \\ b^* &= 200 [f(Y/Y_n) - f(Z/Z_n)] \end{aligned}$$

where

$$\begin{aligned} f(t) &= t^{1/3} \text{ for } t > 0.008856 \\ f(t) &= 7.787 t + 16/116 \text{ otherwise} \end{aligned}$$

Here  $X_n$ ,  $Y_n$  and  $Z_n$  are the CIE XYZ tristimulus values of the reference white point.

The division of the  $f(t)$  function into two domains was done to prevent an infinite slope at  $t=0$ .  $f(t)$  was assumed to be linear below some  $t=t_0$ , and was assumed to match the  $t^{1/3}$  part of the function at  $t_0$  in both value and slope. In other words:

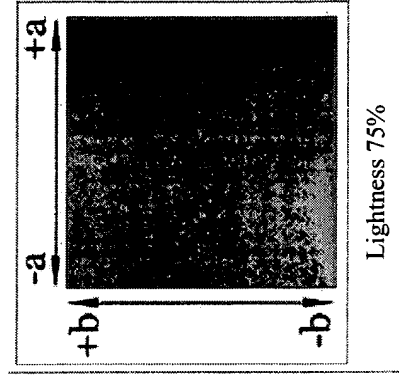
$$\begin{aligned} t_0^{1/3} &= at_0 + b \quad (\text{match in value}) \\ 1/(3t_0^{2/3}) &= a \quad (\text{match in slope}) \end{aligned}$$

The value of  $b$  was chosen to be  $16/116$ . The above two equations can be solved for  $a$  and  $t_0$ :

$$\begin{aligned} a &= 1/(3\delta^2) = 7.787037 \dots \\ t_0 &= \delta^3 = 0.008856 \dots \end{aligned}$$

where  $\delta = 6 / 29$ . Note that  $16 / 116 = 2\delta / 3$

### The reverse transformation





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The reverse transformation is as follows (with  $\delta = 6 / 29$  as mentioned above):

1. define  $f_y \equiv (L^* + 16)/116$
2. define  $f_x \equiv f_y + a^*/500$
3. define  $f_z \equiv f_y - b^*/200$
4. if  $f_y > \delta$  then  $Y = Y_n f_y^3$  else  $Y = (f_y - 16/116)3\delta^2 Y_n$
5. if  $f_x > \delta$  then  $X = X_n f_x^3$  else  $X = (f_x - 16/116)3\delta^2 X_n$
6. if  $f_z > \delta$  then  $Z = Z_n f_z^3$  else  $Z = (f_z - 16/116)3\delta^2 Z_n$

## XYZ to CIELUV & CIELUV to XYZ conversions

### The forward transformation

CIE 1976  $L^*u^*v^*$  (CIELUV) is based directly on CIE XYZ and is another attempt to linearize the perceptibility of color differences. The non-linear relations for  $L^*$ ,  $u^*$ , and  $v^*$  are given below:

$$\begin{aligned} L^* &= 116(Y/Y_n)^{1/3} - 16 \\ u^* &= 13L^*(u' - u'_n) \\ v^* &= 13L^*(v' - v'_n) \end{aligned}$$

The quantities  $u'_n$  and  $v'_n$  refer to the reference white point or the light source. (For example, for the 2° observer and illuminant C,  $u'_n = 0.2009$ ,  $v'_n = 0.4610$ .) Equations for  $u'$  and  $v'$  are given below:

$$\begin{aligned} u' &= 4X/(X + 15Y + 3Z) = 4x/(-2x + 12y + 3) \\ v' &= 9Y/(X + 15Y + 3Z) = 9y/(-2x + 12y + 3). \end{aligned}$$

### The reverse transformation

The transformation from  $(u', v')$  to  $(x, y)$  is:

$$\begin{aligned}x &= 27u'/(18u' - 48v' + 36) \\y &= 12v'/(18u' - 48v' + 36).\end{aligned}$$

The transformation from CIELUV to XYZ is performed as following:

$$\begin{aligned}u' &= u/(13L^*) + u_n \\v' &= v/(13L^*) + v_n \\Y &= ((L^* + 16)/116)^3 \\X &= -9Y u'/((u' - 4)v' - u'v') \\Z &= (9Y - 15v'Y - v'X)/3v'\end{aligned}$$

## RGB and CMYK conversions

Programmers and others often seek a formula for conversion between RGB or CMYK values and  $L^*a^*b^*$ , not understanding that RGB and CMYK are not absolute color spaces and so have no precise relation to an absolute color space such as  $L^*a^*b^*$ . To convert between RGB and  $L^*a^*b^*$ , for example, it is necessary to determine or assume an absolute color space for the RGB data, such as sRGB or Adobe RGB.

Retrieved from "http://en.wikipedia.org/wiki/Lab\_color\_space"

Categories: Color space | Color

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## What is CIE 1976 (L\* a\* b\*) colour space?

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There are perhaps two problems with the specification of colours in terms of tristimulus values and chromaticity space. Firstly, this specification is not easily interpreted in terms of the psychophysical dimensions of colour perception namely, brightness, hue, and colourfulness. Secondly, the XYZ system and the associated chromaticity diagrams are not perceptually uniform. The second of these points is a problem if we wish to estimate the magnitude of the difference between two colour stimuli. The need for a uniform colour space led to a number of non-linear transformations of the CIE 1931 XYZ space and finally resulted in the specification of one of these transformations as the CIE 1976 (L\* a\* b\*) colour space.

In fact in 1976 the CIE specified two colour spaces; one of these was intended for use with self-luminous colours and the other was intended for use with surface colours. These notes are principally concerned with the latter known as CIE 1976 (L\* a\* b\*) colour space or CIELAB.

CIELAB allows the specification of colour perceptions in terms of a three-dimensional space. The L\*-axis is known as the lightness and extends from 0 (black) to 100 (white). The other two coordinates a\* and b\* represent redness-greenness and yellowness-blueness respectively. Samples for which a\* = b\* = 0 are achromatic and thus the L\*-axis represents the achromatic scale of greys from black to white.

The quantities L\*, a\*, and b\* are obtained from the tristimulus values according to the following transformations:

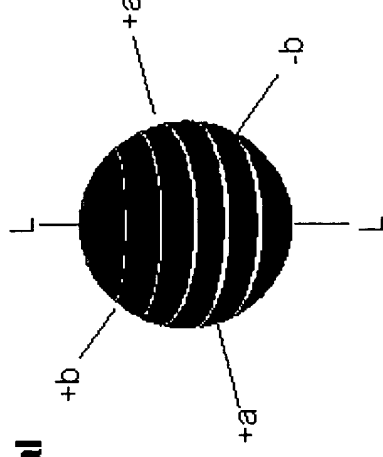
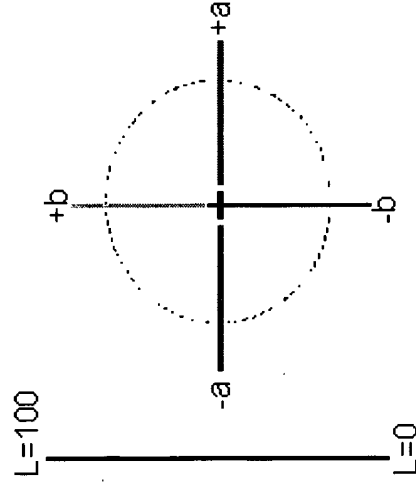
$$\begin{aligned} L^* &= 116(Y/Y_n)^{1/3} - 16, \\ a^* &= 500[(X/X_n)^{1/3} - (Y/Y_n)^{1/3}], \\ b^* &= 200[(Y/Y_n)^{1/3} - (Z/Z_n)^{1/3}], \end{aligned}$$

where  $X_n$ ,  $Y_n$ , and  $Z_n$  are the values of X, Y, and Z for the illuminant that was used for the calculation of X, Y, and Z of the sample, and the quotients  $X/X_n$ ,  $Y/Y_n$ , and  $Z/Z_n$  are all greater than 0.008856. Note: When any of the quotients are less than or equal to 0.008856 a slightly different set of equations is used.

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## CIELAB

colour space is 3-dimensional



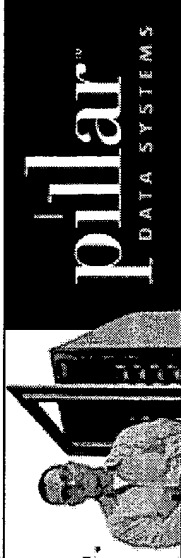
L is the Lightness  
a is the Redness/Greeness  
b is the Yellowness/Blueness

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## Color Space

Quickstudy by Sami Lais

**DEFINITION:** Color space is a way of referring to a model that represents all the possible colors that can be produced by a particular output device, such as a monitor, color printer, photographic film or printing press.

JANUARY 28, 2002 (COMPUTERWORLD) - If you cross the street with the light, check the sky before taking an umbrella, and add the right amount of cream to your coffee, you're making decisions based on information derived from your own personal color space.

Your eyes are delivering that information. They're impressive instruments, more sensitive to the infinite number of colors in the spectrum than photographic

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film is, but not as reliable. Film records those parts of the visible electromagnetic spectrum that are present, whereas the colors you see are influenced by cultural and individual expectations.

Also, your personal color model has no objective standard. Try to describe a color to another person and you realize how difficult it is to translate from your color space to his.

This ambiguity led the Vienna-based Commission Internationale de l'Eclairage (CIE) in 1931 to develop a color space based on data from colorimeters, instruments that can accurately measure specific wavelengths of light. Based on an 1857 model by James Maxwell, the CIE's color space uses the primary colors of transmitted light: red, green and blue (RGB). This prevalent model is additive: Add red, green and blue light and you get white.

A second dominant color space model uses reflected light. This subtractive model attains white by subtracting pigments that reflect cyan, magenta and yellow (CMY) light. Printing processes, the main subtractive users, add black to create the CMYK color space.

The CIE's XYZ (representing red, green and blue) color space measures two components of color—hue (the dominant wavelength, such as red or green) and chroma (the color's purity). But the XYZ color space doesn't match perceived color differences, nor does it describe brightness, the perceived amount of white in a color.

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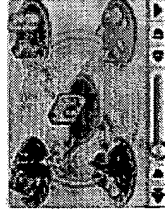
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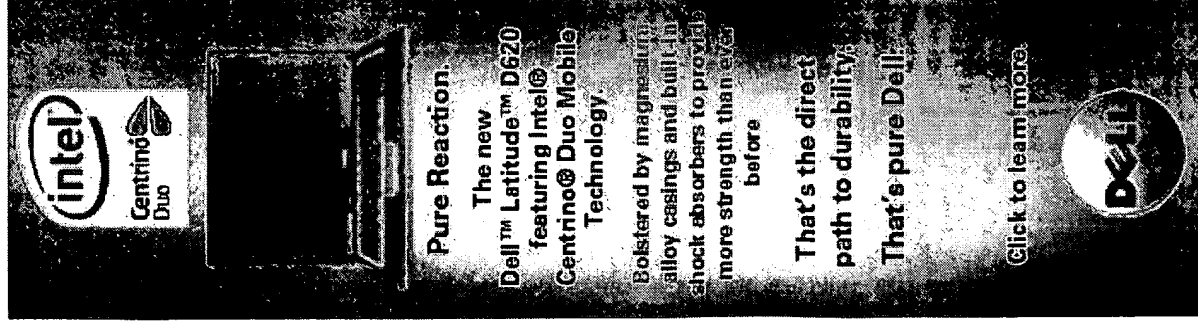
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In 1976, development of the CIELAB color space and a 3-D model allowed the inclusion of brightness measurements. The CIELAB color space remains the most accurate way to measure and reproduce color and is supported by scanners, computers and presses used in high-end print shops.

### Targeted Functionality

Software such as Photoshop from Adobe Systems Inc. in San Jose lets graphic artists select from a variety of color spaces, including RGB, CMYK or CIELAB, depending on how a file will be used. For an image going to a printer, the artist will use CMYK CIELAB to specify color separations.

That's because printed images use reflected light. Red ink looks red because its pigment absorbs the light of its complementary color, green. Printers use the separations produced by software to make separate printing plates for each of the four colors.

For a PowerPoint slide show, an artist will use RGB (also referred to as true color) or CIELAB. Using three bytes per pixel in a color image, most monitors, TVs and digital cameras can represent up to 16,777,216 colors. But critics point out that RGB can't reproduce some colors, such as certain violets.

For high-end color reproduction, neither CMYK nor RGB is good enough; both color spaces are device dependent. Instead, color profiles are used for each output device. A high-end, 24-bit monitor shows colors much truer to the original than a low-end printer.

The device-independent CIELAB color space eliminates some problems. When an image is created, a CIELAB color profile is embedded into the graphics file; reproduction is based on that profile, not on the color space used by the monitor or proofing printer.

However, there are other color spaces used for static images, including very precise color spaces for chemistry and other sciences. And video has its own set of color spaces. To view video on a PC monitor the image must be converted from various analog video color spaces to digital RGB video. Dedicated hardware components on graphics and video accelerator cards speed this color space conversion.

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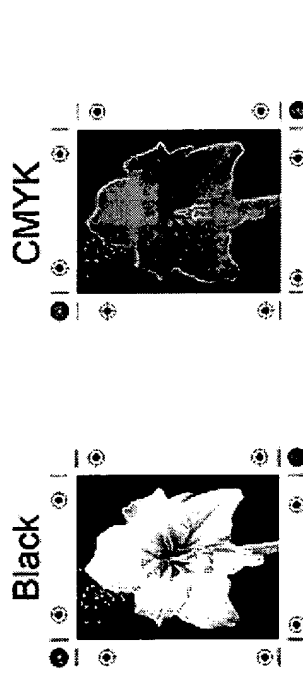
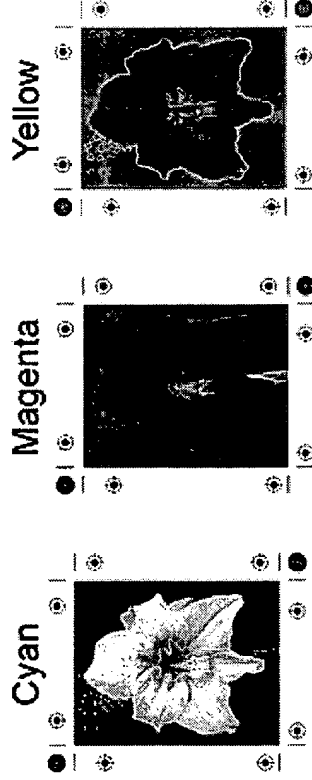
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Organizations like the International Color Consortium in Reston, Va., continue to develop color spaces. But in selecting output devices for most viewing purposes, your first color space is still your best judge: Use your eyes.

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Color separations make separate plates for cyan, magenta, yellow and black. When the four are printed on top of one another, the pigments mix to create realistic color.

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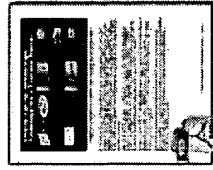
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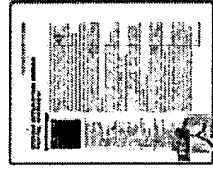


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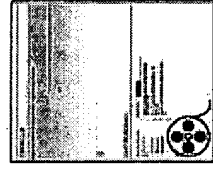


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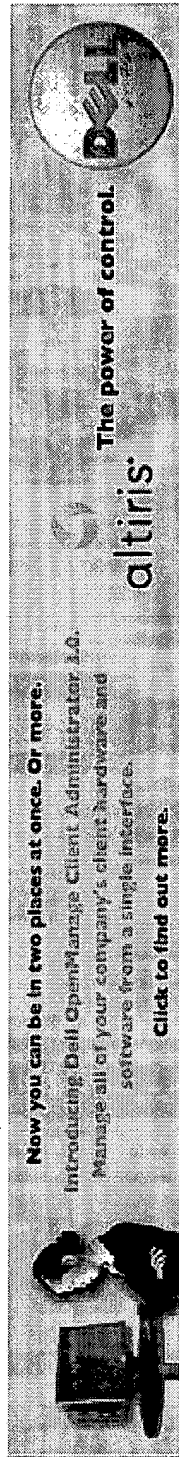
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